

Tides, Water Level and Currents Working Group
Face-to-Face & VTC, 19-22 November 2024
IHO Monaco / Hybrid
Draft Minutes and Action Items – (TWCWG 9)

(Paragraph numbering is the same as the Agenda Item numbering and does not necessarily reflect the order in which matters were discussed. ISO three-letter country codes have been used to identify individual participants)

Section 1. Opening

1.1 Opening Address.

The Chair, Chris Jones (GBR), welcomed all in attendance. As this was the first in-person meeting in several years he thanked the International Hydrographic Organisation (IHO) for hosting the hybrid meeting. A special note of thanks to all for their dedication in attending especially those attending via VTC from very early or late time zone differences was made. It was noted that 57 Member States (MS) were represented as well as 4 from industry and 4 from other organisations were in attendance, giving a good broad representation of the TWCWG community.

The Chair stated that although TWCWG9 was a hybrid meeting, all best efforts would be made to have in-person meetings going forward. A call was made to host TWCWG10 and TWCWG11. The IHO clarified that should a possible host country be able to give a hybrid option that would be a 'nice to have', however, this should not stop anyone wishing to host from coming forward as this was not a stipulation/requirement of being a host country.

The Chair informed those in attendance that it was an ambitious agenda, once again, and all best efforts to maintain the timings, as indicated in the program, would be made. The most prominent agenda and program items being the emphasis on S-104 and S-111 developments with the deadline for implementation rapidly approaching as set out by the IHO and IMO deadlines for the S-100 Implementation Decade (2020-2030). He mentioned that HSSC continues to drive forward with Phase 1 Route Monitoring Mode Product Specifications. Editions 2.0.0 of both specifications are key 'Phase 1' Route Monitoring Mode products and services. Editions 2.0.0 of both S-104 & S-111 are now effectively completed and are currently out for Member State Approval.

As is always the case, the Chair asked all speakers to speak as slowly as they could, as he fully appreciated that English is not the first language of most participants. Those in attendance were reminded to ask for any clarification on any points of discussion that wasn't understood, as it is not a problem to repeat information.

The Chair handed over to Ruth Farre, Vice Chair (ZAF), where she added her opening remarks and comments, wishing all a successful meeting and re-iterating the comments of the Chair.

On 20 November 2024, IHO Secretary General Dr Mathias Jonas and Director Dr John Nyberg addressed the MS present, both in person and those joining via VTC, welcoming them to Monaco and the IHO. Dr Jonas began his address by explaining how the IHO worked and the importance of tides and currents in the hydrographic world. He commended TWCWG on their work over the years and reiterated the importance of the work done by TWCWG. He went on to talk about how important it is that both tide and currents were now being integrated into ENC's, the importance and value that these products will bring to the mariner. Dr Jonas also highlighted the importance that TWCWG brings to the world of climate change and sea-level rise that attributes the WG's member's expertise; helping the IHO to help the world be better prepared for the future.

Dr Nyberg addressed the members present and echoed the welcome given by Dr Jonas. He spoke on the importance of the discussions taking place around S-100 and the value that comes from the work being done

by TWCWG; how this work will give great value to ENC's and how it will improve efficiency for the mariner. Dr Nyberg emphasised that one of the greatest achievements of the S-100 will be because the mariner chose to use these products. After all, they want to and not because they have to. The official photograph was then taken at the IHO.

1.2 IHO welcome.

Sam Harper, Assistant Director at the IHO, stated that the IHO was pleased to host the first in-person meeting in some time. As he has been in the post for 3 years it was his first time attending a TWCWG in-person meeting and he was looking forward to getting to meet many of the MS representatives, specifically with the importance of the S-100 products work that was going to be embarked on during the meeting. He noted the very busy agenda with clear priorities that would follow. The meeting would be recorded for minute purposes with the chat logs being saved as well. General introductions around the room were made by all present.

Section 2. Administrative Arrangements

The Chair mentioned the Agenda Items might be discussed 'out of sequencing order', and that timings were approximate and might be subject to change, all agenda items would be addressed. Morning and afternoon coffee/tea breaks as well as lunch times were included in the program. Sam Harper told all present where the fire escapes and exit routes out of the IHO building were, should they be required for any emergency evacuation. It was noted that as 19 November was the National Day of the Principality of Monaco celebrating 800 years of history, it was a bank/public holiday and the IHO would only have skeleton staff in office. Additionally, the Directors of the IHO would only give their welcome addresses the following day and the official photo would be taken thereafter.

On the evening of 21 November, the IHO will be hosting a light reception in celebration of Beaujolais Day. Sam Harper explained that Beaujolais Day was an annual event whereby that year's wines of the Beaujolais area were legally allowed to be sold.

Each member present at the meeting was asked to login to the VTC platform and how to use the IHO hybrid conferencing was explained. General rules of conduct for the meeting were given.

2.1 Adoption of the Agenda and Apologies

The agenda was adopted and approved. The TWCWG8 minutes were accepted.

Apologies were received from Svein Skjaeveland of PRIMAR who was initially supposed to attend in-person but would now be attending via VTC.

2.2 Programme and Timetable of the Sessions.

The Chair introduced the draft timetable, it was explained that this was intended for guidance only and was not intended to be a rigid structure. Where necessary time spent on individual topics would be amended to allow an appropriate discussion. Regarding 'Meeting Administration' the Agenda Items might be discussed 'out of sequencing order', and the timings were approximate and subject to possible change.

It was announced that the Vice Chair will take the minutes and create the Actions List. As the Current Chair and Vice Chair had just started their 3 year term there would be no re-election of the Chair & Vice-Chair.

2.3 Report on Intercessional Activities including HSSC16.

The Chair reported back on intercessional activities with the main intercessional work having been that of the Project Teams (PT) in the development of S-104 and S-111. Editions 2.0.0 of both Product Specifications (PS) are out for MS endorsement via Circular Letter (CL) CL39/2024 after having been approved at HSSC16. The Chair referenced the workshop of the IAPSO (International Association for the Physical Sciences of the Oceans) Best Practice Study Group on harmonic analysis back in November 2023, with the subsequent Poster Session presented at the European Geosciences Union (EGU) General Assembly 2024, Vienna, 14-19 April 2024. This work is continuing to move forward and will be discussed under Agenda Item 4.3. The Chair reported that the Survey on tides, water level and currents; data production method and data format (S-104 & S-111 products) was to be re-conducted by KHOA. Feedback was given on the work undertaken by the S-44 sub-working group, kindly led by Felipe Rodrigues from Brazil and will be addressed in Agenda Item 6.2. The work undertaken on S-104 and S-111, which was nearing completion was highlighted. The amendments to the TOR's as finalised at TWCWG8 were submitted to the HSSC and will be promulgated to MS for endorsement.

The Chair attended HSSC16 in Tokyo, Japan, on 27-31 May 2024. The TWCWG8 report was well received by the HSSC. The report presentation is available on the HSSC16 webpage. HSSC endorsed the work programme and the continued work with IAPSO.

The Chair went through the action items from HSSC16 which held relevance to this working group.

- 2.3.1 HSSC16/32: S-100 ECDIS Dual Fuel: HSSC noted the work in progress by the S-100WG supported by NIPWG, TWCWG and WENDWG to prepare amendments to the current version of the Dual Fuel Concept for S-100 ECDIS - completed
- 2.3.2 Agenda Item 5.5B: HSSC16/76: Extension of the ISO approach to other PS than S-101, S-98 and S-164 – The HSSC ISO 9001 Cell requested the cooperation and involvement of Chairs from other Working Groups. TWCWG's Chair will attend these VTC meetings. (The Chair briefed the TWCWG on the background to the HSSC ISO 9001 Cell).
- 2.3.3 Agenda Item 5.7: HSSC16/83: S-104, S-111 – HSSC noted the estimated completion date for draft Ed. 2.0.0 of S-104 and S-111 (July 2024) aligned with S-100 Ed. 5.2.0, including a 'light' impact study. This has been completed and will be addressed by the USA under Agenda Items 5.1, 5.2 & 5.3.
- 2.3.4 Agenda Item 5.7: HSSC16/84: S-104 – HSSC noted that Ed. 2.0.0 of S-104 is now designed solely for gridded coverages. TWCWG's requirement for an additional S-10x Water Levels PS, for observations was noted and will be discussed under Agenda Item 5.10.
- 2.3.5 Agenda Item 5.7: HSSC16/85: TWCWG TORs - HSSC approved the minor amendments to the TWCWG TORs (gender neutrality). IHO Secretariat to update the TWCWG webpage accordingly.
- 2.3.6 Agenda Item 5.7: HSSC16/86: M-3 IHO Resolutions - HSSC invited TWCWG/IHO Secretariat to finalize the outcome of HSSC CL 03/2022.

2.4 Matters arising from TWCWG8/Review of Action Items. (ACTION ITEM 1)

No	Agenda / Action Item	Comments	Status	Actions
2.4.1	Action Item 3.7: Inventory of Tide gauges used by IHO Member States	<ul style="list-style-type: none"> MS to review and submit changes or additions if required 	Ongoing	ALL Chair (GBR)/ Vice-Chair (ZAF)
2.4.2	Action Item 3.8: Actual Tides on Line Link status (ATOLL)	<ul style="list-style-type: none"> MS to review and submit changes or additions if required 	Ongoing	ALL Chair (GBR)/ Vice-Chair (ZAF)
2.4.3	Agenda Item 3.9: List of Vertical Datums in use to describe Chart Datum	<ul style="list-style-type: none"> Addition of Epochs [how time is tracked through the vertical datum] used in the calculation. Updated version to be placed on IHO website. Consider a survey to gather this information. 	Ongoing	ALL Chair (GBR)/ Vice-Chair (ZAF)
2.4.4	Action Item 4.1: Water Level Information for Surface Navigation Product Specification (S-104); working toward Ed 2.0.0		Completed	ITEM CLOSED
2.4.5	Action Item 4.1.1: Take forward proposal for S-10x (S-105?) to allow for additional water level information to HSSC to endorse.		Ongoing Cover under Agenda Item 5.10 at TWCWG9	Chair (GBR) S-104PT CAN
2.4.6	Action Item 4.2: S-104 Papers: presentation and discussion		Completed	ITEM CLOSED
2.4.7	Action Item 4.3: Surface Current Product Specification (S-111); working toward Ed 2.0.0		Completed	ITEM CLOSED
2.4.8	Action Item 4.4: 'Strategies and accommodations for use of changed scope S-104'	<ul style="list-style-type: none"> Establish a correspondence group to develop the themes relating to Phil MacAulay's (CAN) initial outline, detailed in "Strategies and accommodations for use of changed scope S-104:" 	Ongoing	CAN BRA GBR PORTOLAN 7'C ARG AUS FIN NOR DEN ESP
2.4.9	Action Item 4.4: Review the ECDIS Dual Fuel concept		Completed	ITEM CLOSED
2.4.10	Action Item 4.4: Engagement with S-100WG and other relevant subordinate bodies	<ul style="list-style-type: none"> This is to possibly provide additional detail for a 'new' S-10x (S-105?) for Water Level data outside of S-104. 	Ongoing	CAN BRA GBR PORTOLAN 7'C ARG AUS FIN NOR

No	Agenda / Action Item	Comments	Status	Actions
				DEN ESP
2.4.11	Action Item 4.7: Survey on tides, water level and currents; data production method and data format (S-104 & S-111 products)	To be carried out and feedback to be given at TWCWG10	Ongoing	KHOA
2.4.12	Action Item 5.3: IHO Charting Specs Tidal levels: B-406.1	<ul style="list-style-type: none"> Still to be addressed To be carried out and feedback to be given at TWCWG10 	In Process	Chair (GBR) IHO
2.4.13	Action Item 8.1: HSWG S-44 improve uncertainty standards	<ul style="list-style-type: none"> Project Team (PT) formed Progress on this will be discussed under Agenda Item 9.1 	In Process	BRA
2.4.14	Action Item AOB 8.3: GI Registry Entry definition of Low Water	<ul style="list-style-type: none"> Still to be addressed To be carried out and feedback to be given at TWCWG10 	In Process	CAN
2.4.15	Action Item AOB 8.4: GitHub TWCWG site	<ul style="list-style-type: none"> Discussion under Agenda Item 5.4 	Completed	ITEM CLOSED

Section 3. National Presentations

National presentations were received from Brazil, Chile, Finland, Japan, Norway and Sweden all of which are available under the meeting document section for TWCWG 9 - Presentations.

3.1 Japan (Masahiro Nambu)

An interesting presentation was shown by the JHOD on the 2024 Noto Peninsula Earthquake, as well as the progress of the introduction of ERS (Ellipsoidal Reference Surfaces) - development of Chart Datum (CD) models. The main focus of the presentation was on the land uplift during the quake. As a result of the quake CD at the Noto Peninsula is no longer accurate and thus has been temporarily deleted from their list of datum levels for nautical charts. The ground movement has resulted in the referencing of CD to benchmarks being unavailable. Specifically in this type of scenario, there is a growing need for some form of Ellipsoidally Referenced Survey (ERS) to create a CD model. Japan discussed the concept of a vertical datum model due to the difficulties now caused in calculating MSL as a result of the ground movement, as well as the effect of the Kuroshio current. In order to restore the CD, GNSS and tide observations are being carried out. The intention is to introduce ERSs on a port by port basis in FY 2025.

FIN asked if they would be using the ERS on port areas only or if they were planning to extend it to all chart coverage areas. Japan responded that their main focus was the implementation of the ERS in the ports first and possibly then implementing it further into their chart coverage areas.

3.2 Chile (Julio Castro, plus support from other SHOA staff)

CHL presented their national report with a focus on their current projects. SHOA commemorated its 150 year anniversary in 2024. They discussed how they supply tides and currents to various MS via International Exchange of Tidal Predictions as per the IHO Technical Resolutions. Their National Ocean Observing Program

now has 48 platforms since its inception 1945, with 1 minute sample rates. This data can be found on the IOC website for those who wish to use it. SHOA also has a network of oceanic wave buoys.

They took part in an S-111 and S-102 training workshop presented by PRIMAR. They mentioned that CHL has entered into a technical agreement to develop ENC's of the Beagle Channel with Argentina where they will be using Lowest Low Water Springs as the vertical datum, whereas Argentina uses LAT. They showed how they analysed the historic and new sea level records and decided that the use of a single datum was not appropriate in this case.

FIN queried if they had received any feedback from users on how they cope with the different datums in overlapping areas. FIN is producing charts/ ENC's with changes in datum and unfortunately the feedback from users has not all been positive. SHOA responded that the surveys and charts had only been done in 2024 so they had not received any feedback from users as yet.

3.3 **Sweden** (Thomas Hammarklint)

SWE presented on the Baltic Sea Chart Datum (2000) [BSCD2000] project, Baltic Sea and Chart Datum, Water level and Currents Working Group (CDWCWG) and also the developments on S-104 and S-111. The BSCD2000 project was a collaboration between 9 countries who have a cooperation for MSI, CD, and other HO obligations. The Baltic Sea Chart Datum, Water Level and Currents Working Group (CDWCWG) has been working on the development of S-104 and S-111; the Baltic Sea is an international shallow, non-tidal area with dense maritime traffic. Initially, for this project, multiple relevant MSLs were used as the CD for most of the charts, however, a geoid model is now being used for this area (therefore "MSL" is now BSCD2000 geoid, based on EVRS). The geoid model does not change with sea-level rise, land uplift or subsidence creating a stable vertical reference level.

The results of the project showed only a difference of 2 - 3 cm between countries' reference levels and these have been registered in the GI registry, and also the EPSG. Several of the CDWCWG countries have already implemented this method of vertical reference levels and others are in the process of implementation. This project shows how successful inter-agency cooperation can be, creating a uniform system from land to sea with a single reference level.

SWE noted that they have one of the longest sea-level records in the world spanning from 1774 to present. SWE is also coordinating the S-104 and S-111 efforts in the Baltic Sea. They are following the IHO time schedule for the implementation of the S-100 series of products in cooperation with the Swedish Meteorological and Hydrological Institute (SHMI).

A question regarding how parapets in the area of the case study affect sedimentation and subsequently the model. SWE responded that the currents in the Baltic Sea are relatively strong in those areas and thus sedimentation build-up is not too much of a concern however, dredging may be required further out to sea. The model used is locally produced software and the modelled data compares very well with Copernicus data.

3.4 **Brazil** (Felipe Santana and André Damião)

BRA's presentation gave an overview of surface currents and water levels in their area of responsibility. BRA has approximately 244 TG's each with a local CD. They are starting to install TG's on their surrounding islands and have found that the radar gauges with solar power are the best options so far. The rivers under a non-tidal influences have been noted to show seasonal variations of up to 4m over the last few years, as a result of this BRA has had to publish MSI notices for the intensified dry seasons.

BRA has produced a Navy hydrodynamic model that can run fore and hind casts. The model and resultant products (i.e. surface currents, tides, magnitudes, etc.) can be viewed on a dedicated website (<https://pam.dhn.mar.mil.br/>). The ultimate goal of the model outputs is for these products to be incorporated into S-111 on ECDIS. Test user feedback, BRA Navy and local mariners has been positive as the information is compatible with cellular/mobile phones making them user-friendly.

A discussion on how the model's products were compared and if the products were 2D or 3D took place. BRA stated that the comparisons showed a high data correlation between the model output and collected data. At present the model output is 2D vertically integrated. The observed depths were used in the model, as the depth affects draught, the model is not yet ready for use for water level just yet. For surface currents, the model shows depth average for the S-111 HDF5 products. So far the model is a depth average model. The model is called SISCORAR and can be downloaded for desktop and cellular use. (www.marinha.mil.br/chm/dados-do-smm/corrente-de-mare). PRIMAR noted that different models are needed for different user cases, thus it is vitally important to use the correct models for each case. Additionally, the models used need to take into account overlaps such as depth layers. As S-111 is currently a surface layer product additional product specifications may need to be created for different layers.

3.5 **Finland** (Anni Jokiniemi)

The Finish Meteorological Institute (FMI) presented their progress with S-104 and S-111, as part of the Baltic Sea and Chart Datum, Water level and Currents Working Group (CDWCWG), as well as their e-Nav project. The FMI is a research and service Agency with a focus on Met Ocean and weather. The presentation showed the structure of the organisation and how both S-104 and S-111 fit into their objectives. FMI has 14 mareographs for sea level observations and 5 current buoys that they are responsible for.

Within the Baltic Sea e-Nav project, the purpose was to start the implementation of the S-100 products within the Baltic Sea. The project was a co-operation with 10 project partners and 4 associated partners involved, FMI was tasked to write the codes to produce S-104 and S-111.

A discussion evolved around how the model dealt with forecasted/modelled information as the model in use for this project is not to a specific vertical reference level. FMI stated that as this is currently a testing phase of the project they will be inserting a testing reference level for Z_0 and this should give the model better test outputs. The GBR and USA stated that they used a geopotential surface and then removed the geoid in their models.

3.6 **Norway** (Hilde Sande Borck)

NOR presented a national report that highlighted how they are expanding their tide gauge (TG) network with permanent TGs, some of them being co-located with geodetic equipment and 20 stations now having real-time data. Due to a change in user needs the 6 new stations have been equipped with improved modelled outputs (i.e. how these new station interact and complement their existing tidal regime polygon system where they divide their network into tidal zones). Some of the new user needs include, but are not limited to, climate change projects and civil protection, better under keel clearance information and port operations; all of which have expectations for the information to be easily input into GIS software and more user-friendly products. The Norwegian Hydrographic Service's new main focus is on storm surge and changes within MSL, specifically where in Norway these will affect locations on land. There is a need for a better connection between MSL and land zero/ordnance datum.

NOR plans to produce both S-104 and S-111 products but they will not be made using models. Their biggest challenge is creating these products using astronomically forecasts within zones. ZAF and NZL stated that they are having a similar problem. ZAF mentioned that they are having a VTC with the UKHO regarding this issue

and suggested that NOR and NZL join this meeting.

Section 4. Programme Matters.

4.1 Standard Constituent List.

GBR reported that there have been no new updates. The Standard Constituent List can now be seen as more of a reference document than a living document as it is doubted that any more updates, contributions or changes will be made to it. It contains a list of a large number of harmonic constituents commonly in use, showing the Constituent Name (grouped by species of constituent). The list provides the speed of the constituent in degrees per hour, the Extended Doodson Number (numerically and alphabetically) and the application of the nodal correction to each constituent. A discussion was held on how this list now links closely to the work of the IAPSO Best Practice study group. During an IAPSO workshop, a year ago, discussions suggested identifying the ‘core’ harmonics in the main list and explaining why there are sometimes 2 ‘versions’ of the same harmonic constituent. As that best practice document develops, it may be the case that this Standard Constituent List is integrated or subsumed within that.

4.2. The study of long-term data sets for the determination of global sea level rise and changes in tidal range.

The Chair reported that this has been discussed at many meetings with the concept of epochs being used. NOR and the USA reported that there were no updates and the United Kingdom’s National Oceanographic Centre (NOC) had not submitted any updates either. NOR suggested that the current title ‘*The study of...*’ is no longer a TWCWG topic, but more a GLOSS topic. However, it was noted that the action to identify the epochs used in the selection/calculation of MS national vertical datums is of great value, and adding this information to the *List of vertical datums used to describe Chart Datum* should be considered. Doing the previously suggested would be a good way to spread awareness of the importance of this, so it might still be relevant. A decision was made to revamp the title for 4.2 to make it better reflect the required task.

ACTION ITEM	Action Required	Actions	Deadline
2	A decision was made to revamp the title for 4.2 to make it better reflect the required task	Chair (GBR) USA (Peter Stone) NOR	TWCWG10
3	Epoch information could be added to the Chart Datum list. This should be applied if and when needed, thus the epoch will indicate when the update was applied.	ALL Chair (GBR) Vice-Chair (ZAF)	TWCWG10

4.3 Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software (including Application for International Association for the Physical Sciences of the Oceans (IAPSO) Best Practice Study group on Tidal Analysis)

A brief history was given by the Chair. Andrew Matthews (NOC) gave an update on IAPSO stating that the purpose was to write a best practice document/ more practical guide for tidal analysis. Once completed, this document will be submitted to the IOC Ocean Best Practices website (www.oceanbestpractices.org). NOC has collated all the information and created a ‘Chapter 1’ which is the first draft. Chapter 1 has been placed on Google Drive along with an example of a constituent set. The document still needs sections on Satellite data, model data, analysis of currents, techniques other than harmonic analysis and third-degree tides. The addition of real use cases, as examples, would be very helpful to add to this document as well.

A plea for assistance from TWCWG MS to check Chapter 1 to confirm if the datasets are correct, if anything still needs to be included and any additional comments that can be used to improve the document. Chapter 1, along with any TWCWG comments will be discussed at the next GLOSS meeting, early 2025 (11-14 March 2025). The final version of the document is planned to be ready in time for the IAMAS*-IACS**-IAPSO Joint Assembly on 20-25 July 2025.

(IAMAS = *International Association of Meteorology and Atmospheric Sciences*; IACS = *International Association of Cryospheric Sciences*)

A discussion was held on various commercial software (i.e. T-tide, U_tide, Pacmaré, CO-OPS, etc.) that can be used for tidal analysis and how they compare with traditional harmonic analysis software using the Foreman method and still programmed in FORTRAN. ZAF mentioned that they have been working on their in-house software using the Foreman method and still programmed in FORTRAN into Python script. The State Information and Technology Agency (SITA) has written all the scripts in Python but left the calculations in FORTRAN, thus eliminating the ability to have the calculations altered. This project is now ready for its second test phase by SANHO.

CHL presented results of a case study of non-stationary tides in Puerto Natales, Chile, which is located in the fjords (<https://www.ioc-sealevelmonitoring.org/station.php?code=pnat2>), and which leads to a strong non-stationary tidal behaviour. They have used several analysis programs in search of the best result (sprl2, U_tide, T_tide, S_tide and NS_tide), and we are still studying which one is the best.

NOAA (Lindsay Abrams & John Callahan) gave a talk on their work in comparing harmonics between their legacy in-house analysis software with those from U_tide, explaining the existing methods and the motivation behind the reasons in wanting to update their approach. Lindsay explained the rational in using U_tide, and that the takeaway was the Python implementation of the U_tide code, with the same 37 constituents as the traditional method, compared very well (just minor differences). She detailed that CO OPS predictions don't incorporate MSL rise, and that the CO-OPS traditional prediction applied the phase shift of Sa & Ssa at the **prediction** stage whereas U_tide calculated these 'already' in the analysis stage. NOAA have also looked at AI/machine learning but these require more investigation. Nonstationary analysis on the River Columbia was also briefly discussed.

The talk from NOAA generated much discussion; John Callahan mentioned that he had had some discussions with the U_tide & T_tide authors and the potential to integrate these into NOAA processes.

BRA also presented their work on comparisons of their Pacmaré analysis software against U_tide, noting that U_tide doesn't perform cross-analysis, and that Pacmaré was written in FORTRAN.

ACTION ITEM	Action Required	Actions	Deadline
4	<ol style="list-style-type: none"> Anybody wishing to be involved in checking the IAPSO Chapter 1 can email Andy (antt@noc.ac.uk) to gain access to the document. MS participating in this action to submit comments/feedback on the metadata list to Andy Matthews 	<p>ALL</p> <p>USA NOR GBR NOC</p>	15 Feb 2025

4.4 Historical data recovery/data archaeology.

NOC and GBR gave a brief history and feedback on the status of Historical data recovery/data archaeology. NOC reported on their citizen science project, whereby the general public was asked to assist with this project. The final QC of the crowd-sourced / Citizen Science project for two sites in the UK was underway. To date, 50 years' worth of historical data has been recovered before it was lost.

NOC gave feedback on the outcomes from the GLOSS meeting in July 2024 on data archaeology. Some of these outcomes included the dissemination and feeding of a contact list, https://docs.google.com/spreadsheets/d/1_4TSioee9goKXlFLeXWJN70RfioTkh3RRAdBF7d6Es/edit?usp=sharing establish a data repository for the publications, reports, inventories and documentation relevant to the working group and establish a webpage for advertising and sharing of recommendations. Additionally, a sub-working group would be created to look at the data inventory (common format, list of needed metadata, data that needs digitizing), tools to process the sea-level data and data in sparse areas.

SHOM (Gael Andre, FRA) showed a presentation on historical data recovery and tide gauge series reconstruction. Some of the recovered data and series reconstructed came from 9 historical tide gauges that date back from the 19th century to date. The recovery and reconstruction project is being carried out on the French coastline (with the intended completion date being end 2026) as well as in several African Countries (including Cameroon and Cote D'Ivoire). This project has been funded by SHOM and the French Ministry of Ecology.

(<https://refmar.shom.fr/data-archaeology/liste-inventaire>)

4.5 Establishment and Maintenance of VRF for High Resolution Bathymetric Surfaces.

NLD (Ronald Kuilman) gave feedback from the 26th North Sea Hydrographic Commission Tides Working Group meeting (NSHC TWG26). The problems with seamlessly integrating multiple boundary differences; where there is a difference in LAT between countries, was discussed further. The presentation showed the individual differences between MS at the common North Sea national boundaries, as well as the larger differences between GBR v France. Many of these differences are significantly large which is problematic. The presentation highlighted a contoured display of the LAT surfaces when the LAT difference is equal to or less than $\frac{1}{2}$ the TVU norm then it would be acceptable. Further work on improving the seamless integration is needed and a roadmap for the way forward has been developed. The GBR and SHOM are working towards a better agreement at their national boundary in La Manche / English Channel. Brazil suggested that a possible solution could be found by comparing ellipsoidal references verses LAT along these borders.

4.6 Determining ellipsoidal height of MSL at the coast.

AUS presented their work on developing a software program called AusHydroid. AusHydroid defines the GNSS survey method to CD, it then solves for the coastline vertical datum problem. AUS noted that it is very difficult to produce a 2D surface due to the linear datum and station distribution. They currently have 551 points, where most of them have a good ellipsoidal height and Australian height data. AUS went on to discuss the challenges and how they are attempting to overcome them. A major challenge and their current main focus is on connecting the land and sea vertical datums. A question was posed on the possibility of using GNSS reflectometry to rectify the aforementioned problem. AUS stated that they are looking into this as a possible solution and also using GNSS as a 'tide gauge'. The GBR and NOR indicated that they have papers on this topic and will share them with AUS.

ACTION ITEM	Action Required	Actions	Deadline
5	The GBR and NOR indicated that they have papers on this topic and will share them with AUS.	GBR NOR	28 Feb 2025

4.7 Inventory of Tide gauges used by IHO Member States.

The Chair gave some background on this topic and mentioned that the last update of this document was 19 May 2020. Updates have been received from ITA, NOR and FIN since TWCWG8, the list has been updated and will be published soon. The list is not only an *Inventory of Tide Gauges* but **Current meters** used by MS as well. He reminded all present that the information was available on the TWCWG webpage. Any new information and/ or updates to please be forwarded to the Chair. MS were reminded to check that the links in the document still work. Italy, Norway and Finland were thanked for their updates.

ACTION ITEM	Action Required	Actions	Deadline
6	<ol style="list-style-type: none"> 1. Member states to review content and check web links still point to correct location. 2. Submit changes to Chair and Vice-Chair. 3. Updated version to be placed on IHO website 	ALL Chair (GBR) Vice Chair (ZAF) IHO	TWCWG10

4.8 Actual Tides On-line Link status.

No updates have been received. The Chair suggested that the parent website should be included in an attempt to make it less work to check each and every website link. The Chair said he would monitor the progress on GLOSS's work to create a singular portal, once that is complete we can bring this agenda item to its natural conclusion.

ACTION ITEM	Action Required	Actions	Deadline
7	<ol style="list-style-type: none"> 1. Member states to review content and check web links still point to correct location. 2. Member States to add parent website to the list 3. Submit changes to Chair and Vice-Chair. 4. Updated version to be placed on IHO website 	ALL Chair (GBR) Vice Chair (ZAF) IHO	TWCWG10

4.9 List of vertical datums in use to describe Chart Datum.

No updates have been received. TWCWG7 and TWCWG8 referred to a request for MS to supply details about their 'epochs' used in their selection / calculation of their national vertical datums and add them to the List of vertical datums in use to describe Chart Datum. Definition of Chart Datum and any additional relevant information should be added as a note. Brazil suggested that perhaps the list could be expanded to include datums for navigable rivers as well, this was collectively agreed to.

ACTION ITEM	Action Required	Actions	Deadline
8	<ol style="list-style-type: none"> 1. Member states to review content. 2. Addition of Epochs [how time is tracked through the vertical datum] used in calculation. 3. Submit changes to Chair and Vice-Chair 	ALL Chair (GBR) Vice Chair (ZAF) BRA (Felipe Santana)	TWCWG10

	4. Updated version to be placed on IHO website	IHO	
	5. Consider a survey to gather this information.		

Section 5 – Product Specification Updates & Presentations (S-104 & S-111).

5.1 Water Level Information for Surface Navigation Product Specification (S-104); Ed 2.0.0 Report.

USA (Raphael Malyankar) discussed the significant updates to S-104 made in line with comments from TWCWG and HSSC as follows:

He outlined the now reduced scope of S-104, to just provide a means for the ECDIS to perform Water Level Adjustment (WLS) in conjunction with S-98.

- S-104 is now aligned with S-100 Edition 5.2.0
- Removed Annex B (Additional terms.)
- Added uncertainty attribute to values record
- Adopted fileless cancellation method for cancelling datasets
- Annex D (Sample HDF5 Encoding) removed
- Annex E (Validation) removed (will be in S-158:100 & S-158:104). The 'Combined list' of checks is no longer part of the package.
- Extended format to include grids with datum jumps (multiple vertical datums).
- Data quality clause checked by DQWG.
- Added description of regular grid spatial type (reviewer request)
- Added UTM zones to align with S-102 and newer WGS84 realizations
- Expanded information about conformance with S-98
- Removed descriptions of portrayal and S-104 portrayal catalogue.
- Added information on defining feature identifiers if needed
- Added provision for optionally having data points in grid cell centres. This was done for the potential alignment of cells with S-102, which recently decided to put its data points in grid cell centres. (Jan. 2024)
- Removed ISO metadata files
- New epoch attribute for vertical datum epoch. Reviewer request.
- Updated language about omitting unused optional attributes from Group_F. This was done for strict conformance with S-100

Raphael Malyankar indicated that the S-98 was not yet stable and this was being worked on to rectify the matter. The above changes to S-104 now make it possible to align S-104 grids precisely to S-102 grids. The IHO circular letter CL39/2024 was out for MS approval of S-104 Edition 2.0.0, with a deadline of 13 Dec 2024. The USA (Greg Seroka) gave feedback on the ITRF2020; when using WGS84 offshore the use of ITRF2020 was for navigation in waters deeper than 40m.

FIN noted that in S-100 part 10c which defines the HDF5 data model, the grid spacing was taken from the S-102 WG. He also made note of S-98 interoperability which will be covered in Agenda Item 5.12.

ACTION ITEM	Action Required	Actions	Deadline
9	Capture relevant comments in response to CL39/2024	Chair (GBR)	12 Dec 2024

5.2 Surface Currents Product Specification (S-111); Ed 2.0.0; Report.

USA (Raphael Malyankar) discussed the significant updates to S-111 made in line with comments from TWCWG

and HSSC as follows:

- S-111 is now aligned with S-100 Edition 5.2.0
- Provided for non-uniform time series in moving platform data, including propelled platforms.
- Removed Annex B (Additional terms.)
- Added directionUncertainty and speedUncertainty attributes to values record. This means encoding node-wise uncertainty is now possible
- Adopted fileless cancellation method for cancelling datasets
- Annex E (Sample HDF5 Encoding) removed
- Annex F (Validation) removed (will be in S-158:100 + S-158:111). The 'Combined list' of checks is no longer part of the package.
- The data quality clause has been checked by DQWG.
- Added UTM zones (to align with S-102.) and newer WGS84 realizations
- Added information on defining feature identifiers if needed
- Added provision for optionally having data points in grid cell centres. This was done for the potential alignment of cells with S-102, which recently decided to put its data points in grid cell centres. (Jan. 2024) (S-104 also added this.)
- Removed ISO metadata files.
- Additional guidance on dataset production and metadata.
- Clarifications for S-98 compliance.
- Updated language about omitting unused optional attributes from Group_F. This was done for strict conformance with S-100

USA (Raphael Malyankar) commented on S-111 Ed 2.0.0 provided for non-uniform time series in moving platform data. Requirements as per TWCWG MS comments, as well as those from HSSC and S-100 WG were added. Member State approval is now being awaited, the deadline for this is 13 Dec 2024.

5.3 S-104 & S-111 Impact Studies.

USA (Greg Seroka) reported back to the WG on the light impact studies/user case studies. The IHO resolution 2/2007 emphasizes the need to consider the impact on stakeholders. Case studies are required for all S-100 Phase 1 product specifications (PS). Light impact studies were carried out through various contributors and participants. USA discussed the results that were received from the surveys on S-104. Of the results obtained, 50% were confident that they could produce and implement S-104 products. However, of the remaining 50% of respondents, 10% lacked confidence in full understanding, 30% had read and fully understood the details of the PS and the remaining 10% had yet to study the PS.

USA discussed the results that were received from the surveys on the S-111 survey. Of the results obtained only one-third of respondents were confident that they could produce and implement S-111 products. Of the remaining two-thirds of respondents, 20% lacked confidence in full understanding, 30% had read and fully understood the details of the PS and the remaining 20% had yet to study the PS.

He stated that the free text from some responses highlighted a potential need for further guidance. FIN asked if there were any actions resulting from the light impact study?; USA response that S-164 test datasets were a key part of the development of S-104 & S-111 deliverables.

The light impact studies have been completed and the documents from the impact studies can be made available to MS. This information has been submitted to HSSC for approval. USA was requested to supply the documents submitted to HSSC for uploading to the TWCWG webpage or on GitHub. Several MS indicated that

they had now received the link to complete the above-mentioned surveys. It was decided that the survey links would be placed on the TWCWG webpage for MS wishing to complete the surveys.

ACTION ITEM	Action Required	Actions	Deadline
10	USA was requested to supply the documents submitted to HSSC for uploading to the TWCWG webpage or on GitHub	USA (Greg Seroka)	TWCWG10 Completed 27/11/2024

ACTION ITEM	Action Required	Actions	Deadline
11	1. Survey link to be placed on the IHO website 2. MS to complete the survey 3. Feedback on the survey be given/ presented at TWCWG10	IHO ALL USA (Greg Seroka)	TWCWG10

A discussion was held pertaining to the percentage of MS who did not feel competent to produce either S-104 or S-111 products. The USA indicated that there is guidance for producing these products in development. This guidance will be provided upon completion.

5.4 The TWCWG GitHub repository.

The USA (Raphael Malyankar and Greg Seroka) showed the latest editions of S-104 and S-111 that have been added to the repository. The structure and content of the repository was discussed. MS can register on the GitHub repository to gain access to information provided there. MS are encouraged to create an account to add documents, however it can be viewed without an account. The URL for the GitHub Repository is <https://github.com/iho-ohi/TWCWG>. This link should also be made available on the TWCWG webpage.

The IHO also has a repository however it does not include TWCWG. In order to add files to this repository special permissions need to be applied for. Yong Baek from the IHO (via Raphael) emphasised that GitHub is mainly for development. Main and completed work is available as final published documents on the IHO website.

Sam Harper from the IHO asked for a show of hands of those present as to who had any experience with GitHub. GitHub is only proficient with 4/30 members in the room. It was suggested that consideration be made for TWCWG10 that some form of 'up-skilling' needs to be done, possibly a presentation on the basic use of GitHub or an introduction to GitHub/basic training be carried out at the next meeting. The USA, (Greg Seroka) displayed the TWCWG GitHub site and showed a quick overview of the basic user account and how to use it.

ACTION ITEM	Action Required	Actions	Deadline
12	MS encouraged to register on the GitHub repository to gain access to information provided there.	ALL	TWCWG10
13	Add the URL for the GitHub Repository to the IHO website https://github.com/iho-ohi/TWCWG	Chair (GBR) Vice Chair (ZAF) IHO	March 2025
14	Presentation on the basic use of GitHub or an introduction to GitHub/basic 'how to use' training to be carried out.	IHO CHAIR (GBR) USA (Greg Seroka)	TWCWG10

5.5 **S-158 (Validation Checks) report; S-158:100; Validation Checks in general.**

USA (Raphael Malyankar) gave feedback on the S-100 Validation Checks Sub-Group report that was presented at the 9th S-100 WG meeting (S-100 WG9). The S-100 Validation Checks Sub-Group held four VTC meetings throughout the year. The deliverables of the sub-working group are as follows:

- Naming convention of validation checks
- Standardisation of the template
- Agreed S-158:1xx format for PS validation checks, Removed from inside of the PS
- S-100 validation checks
- S-98 / Cross Product validation checks tests for use on ECDIS

The S-100 Validation Checks Sub-Group completes validation checks as assigned by HSSC that are relevant to S-100 and each PS for Phase 1. They were tasked to create a standardised format for validation checks and naming conventions. There is a template structure that has been produced to show the process as well as the meanings/descriptions of each of the checks. The maintenance procedure for checks and how to handle/manage impact studies were also discussed. The contract has been awarded to Portolan to produce the S-100 validation checks and cross-product validation documents.

Of specific note was the long-standing issue of how to list multiple clauses in S-158:100. The Sub-working group agreed to use box brackets to separate clause numbers for different documents. It was noted that language consistency is important over products and countries; this might result in a possible need to revise the language in the future. In the longer term, the S-100 Validation Checks Sub-Group will establish a Validation Checks Registry within the IHO registry once they have coordinated with the ICE-PT on how to proceed. Issues with regard to the Classification of Validation Checks and versioning have been discussed and are now under discussion with broader S-100 WG. The sub-group has its next VTC in January 2025.

Raphael also mentioned that There is a VTC on X-validation checks coming up on 9th December 2024 to discuss cross product validation, focused on Water Level Adjustment (WLA). NLD (Ronald Kuilman) asked about S-129 validation and if there were any checks between S-129 & S-104; USA (Greg Seroka) stated that S-129 is agnostic to S-104, and for the WLA we should focus on uncertainty checks.

5.6 **S-104 Validation and S-158:104; progress to date.**

5.7 **S-111 Validation and S-158:111; progress to date**

Agenda Items 5.6 and 5.7 were discussed simultaneously at this time.

The USA (Raphael Malyankar) reported back on the commonalities between the previous presentation (Agenda Item 5.5) and Agenda Items 5.6 and 5.7. He presented the evolution of the validation checks and the structure of the documents, subsequent documents, and how many of the checks are structured similarly to the 'original' S-58 list of checks, i.e. the evolution of the S-58 validation checks and the 'new concept' of S-158:1xx. The list of standalone checks, as based on the S-100 based products, and the combined list are in the GI registry. The S-104 PT and the S-111 PT are moving forward with the updating of Edition 2.0.0 to be ready for HSSC17. It was advised that each PT undertake multiple rounds of reviewing and revising the documentation before submission to HSSC.

The PTs requested clear instruction, to avoid ambiguity, on the required tasks they need to complete. Portolan was tasked with a simplified 'to-do list' for the relevant PTs. Tasks include the need to covert the combined checklist to conform to Ed's 2.0.0

ACTION ITEM	Action Required	Actions	Deadline
15	The S-104 PT and the S-111 PT are to move forward with the updating of S-158:104 (which currently relates to Ed 1.1.0 of S-104) and S-158:111 (which currently relates to Ed. 1.2.0 of S-111), to make them conform to Eds 2.0.0 of S-104 & S-111, to be ready for HSSC17.	S-104 PT and the S-111 PT	06 March 2025
16	The S-104 PT and the S-111 PT to check the existing S158:104 and S158:111 validation checks.	S-104 PT and the S-111 PT	06 Dec 2024 Completed with no comments received by any MS
17	Portolan was tasked to create and bulleted list of the approach to take to get the S158:104 and S158:111 updated to Ed's 2.0.0 of both PS.	Portolan (Raphael Malyankar) Chair (GBR)	Completed and emailed to Chair on 06/12/2024 for distribution to PTs
18	Reach out to HSSC for expectations/timeline for validation checks updating.	Chair (GBR)	HSSC17

5.8 Production of S-104:

5.8.1 Representing station-based data in regular grid format.

CAN reported back to the Working Group on the progress and work done by CAN on representing station-based data in regular grid format. CAN has progressed to 3D models in this regard however data-based grids can be used in a 'mini' grid that fits within the S-104. CAN showed their compilation of *Strategies and accommodations for use of newly restricted S-104* document, where mini grids are used. These mini grids are located around a tide gauge. PRIMAR questioned what a mini-grid was; CAN responded that it was creating cells that were small enough so that the water level would be constant across that cell i.e. uniform water levels around a TG. BRA enquired how this method would be used to handle storm surges and whether predictions or a model was used, CAN responded that this would need to be specified to the user.

AUS stated that they used CAN's document and created an example, only producing S-104 and S-102 for a small area, on a large-scale ENC (i.e.: berthing areas) so that the water level height was the same across each point within the area. They took a traditional prediction for the area (20 min interval predictions) and used those for creating the S-104 and S-102 example products. It was found that for the grid sizes the files were extremely large, to combat this they changed the grid sizes vs the data set (using traditional predictions). This methodology worked and is lower cost. BRA enquired how to handle zones of Influence, GBR suggested how they had handled this and indicated that they could provide a breakdown of the approach taken.

NOR enquired if it would be possible to collect various methodologies and place a compiled 'list of methods' on GitHub, making it easier to connect with MSs using similar methods. CAN was tasked to provide various strategies to assist. CAN was tasked to create a collated document of all the various methodologies being used for applying either models or predictions to the grids. It was also decided that this would be a good idea to collate a document of what MSs are doing to create S-104 products, their process of creation and how they are getting the information into HDF5. NOR and ZAF volunteered to compile this information.

ACTION ITEM	Action Required	Actions	Deadline
19	<ol style="list-style-type: none"> 1. Re-engage the subgroup to look at and discuss the strategies and methods of application of what could be done. 2. Provide a list of the various strategies - collate all the various methodologies being used for applying either models or predictions to the grids 	CAN ALL	TWCWG10
20	<ol style="list-style-type: none"> 1. Create a survey to be distributed to all MS. 2. Collate a document of what MSs are doing to create S-104 products, their process of creation and how they are getting the information into HDF5 	NOR ZAF ALL	25 June 2025 28 Aug 2025 for TWCWG10

5.8.2 Uncertainty, (vertical datum) epochs, interpolation, method of evaluation (processing techniques, quality of input data, etc.).

BRA mentioned that the accuracy of S-104 is important to the mariner using the product. Examples of factors that can affect the information accuracy of data sets being used was discussed. These factors could include, but are not limited to, spikes, lack of data, phase shifts etc.; that would need to be evaluated/validated for real-time tide in S-104. Specific note to the random errors or statistical errors within the data being used would need to be taken into account. When using predicted or forecast data the accuracy of the harmonic constituents and the longer the time series resulted in the lower errors. This is dependent on the method of how the harmonic constituents are calculated and the predictions are forecast. For the CD (Z0)/ accuracy of the vertical datum is also dependent on the length of the time series. Thus the longer the time series used the lower the uncertainty.

When using models, the statistical interpolation and computational interpolation only takes into account the mathematical calculations and not reality so the uncertainty is higher. BRA led a discussion on the use of models, querying what the levels of the standard deviation should be used or if the maximum uncertainty was better to use for maximum safety.

Vertical errors are more complex, specifically with changes in CD over the coastline. BRA stated that when using real time in S-104 the product will need to take into account changes of CD over different areas. BRA led a discussion on how best to 'link' these gridded areas to take into account the changes in vertical datums. USA (Peter Stone) stated that NOAA calculates datums strictly from the observations. The GBR (Thomas Cropper) discussed the uncertainties as well as the possible ways to keep the mariner safe. MSs need to ensure that they are not doubling up on uncertainties incorporated into the depths. PRT suggested that this may already be covered in the S-98 Annex C. It was decided that this needs further investigation and possible collaboration with other S-1xx working groups for TVU.

ACTION ITEM	Action Required	Actions	Deadline
21	This needs further investigation and possible collaboration with other S-1** working groups for TVU.	BRA USA	TWCWG10

5.9 Next editions of S-104 and S-111 (When? Changes beyond Ed 2.0.0).

After some discussion, it was decided that right now the focus is on Ed 2.0.0 and getting this out for implementation. Additionally, looking ahead it was decided that producing a possible new edition could be aimed for nearer to phase 2, 2029.

5.10 Additional S-10x; e.g. 'S-105' (for all detail 'removed' from the original S-104).

The Chair reported that he had discussed this at HSSC16. He enquired if it was possible to build S-105 to address the sections that were removed from S-104 during the pair; essentially creating a new product. At present, this has not yet been approved by HSSC. The Chair noted that with the work and processes that are currently in progress, perhaps it would not be necessary right now to do an S-105 type product. He suggested that it might be prudent to hold off on this for the moment. USA (Greg Seroka) stated that with the amount of work that is still needed to be done, not only on the S-104/S-111/S-102 etc., perhaps holding off on this for now would be a good idea.

CAN suggest that the existing structure from the "pre-pared back" / reduced scope specifications can be used thus eliminating some of the new workload that would be added. A discussion was held on the possibility of an S-105 product and how this could be done effectively. The IHO noted a general point of process whereby if TWCWG wanted to do this in the future, a detailed paper of the consequences of an additional product outlining the pros and cons of a new product would need to be submitted to HSSC. This paper would need to show the added value that such a new product would have to the mariner before HSSC would permit the creation of new products. With the aforementioned paper presenting a robust case, HSSC should approve a new product in years to come. The Chair suggested that TWCWG collate all the information the MS would like to see in an additional product, write a paper on the requirement and then propose this to HSSC. The consensus was to carry this item over to TWCWG10. In the meantime, MS could put together the requirements they felt necessary for a possible S-105 product to be discussed at TWCWG10

ACTION ITEM	Action Required	Actions	Deadline
22	<ol style="list-style-type: none"> 1. Collect and collate all the information required for a possible S-10x product 2. Collect all the information (pros/cons, requirements etc.) required to write a detailed paper for HSSC 	CAN GBR USA Portolan (ALL)	TWCWG10

5.11 S-104 & S-111 Member State developments, Use cases, etc.

BRA reported that their S-111 and S-104 user case studies are completed, specifically their surface water adjustment model, but are not linked to a vertical reference datum. BRA intends to make the vertical references of the model the same as the tide gauges and the charts as well. Their current challenge is to convert multiple CDs to HDF5. Within their S-111, the oceanic model runs once a day with forecasts of up to 4 days using a 4km area. They are having a problem with the conversion from NetCDF to HDF5, the NOAA viewer has been of help with this and it plots the information well. They have tried the KHOA model viewer which does not seem to be working for Brazil. BRA have sufficient external information to validate their model.

AUS mentioned they had some issues with their products as well, but it was due to the large file size. They have had some good feedback from recreational users and their Navy which has been helpful.

NLD is undertaking S-100 stacked data trial production. The objective was to show stacked layers S-101, S-102, S-104 and S-111 as a grid scheme. NLDs used Caris Composer to integrate the source data of S-57 ENC data,

multiple developers and departments have collaborated on this trial. The trial resulted in the SATIS API (system built by NLD) developed for the production of S-104 and S-111 by pulling data directly from their databases and converting it into products. For S-104, this method is useless without S-102, however, the DCF2 file sizes are large as both datasets must have the same grid size and coordinates. One of their challenges is how long will they have to produce the S-57 products and how long dual fuel needs to be delivered. The NLD was asked if the tools for the API would be made available to everybody (MS). NLD responded that they should be available and the code will be made widely available from NH.

FRA showed a presentation of the results obtained from their joint trial with the GBR (UKHO – SHOM). The trial is working towards a test transit across the Channel from Portsmouth to Saint-Malo on Condor Ferries. The trial will be to test the readability and graphic representation of S-104 and S-111, as well as the consistency of the S-104 and S-111 products. So far the results have been satisfactory, there is a need for a visualization tool to manipulate files to take HDF5 files into an animation. FRA requested if anyone has such a tool and if so to please share it if possible. GBR stated the visualisation from HDF5 is fine, but the use of NetCDF files are currently easier to convert. It was noted that FRA does not interpolate data.

CAN reported on their S-100 sea trials in the St Lawrence River which is designated to take place in 2025. The focus will be on the S-100 route monitoring system. The St Lawrence River has a 6m tide with dredged channels and strong currents within the trail area. CAN will use a number of models with a parent-child scheme. The sea trial area is approximately 350km/190 nautical miles of busy commercial waterway that transitions between tidal and non-tidal behaviours over 170 km within the trail area. Due to the conditions in the St Lawrence River, ships going up the channel try to 'surf' the High tide in order to have the highest draft, which created a difficulty in the model versus the mariner's 'use'. Mariners have requested a 15 min forecast interval.

BRA asked if it was possible to share the coding and how the DCF=3 file was converted/created and if there was interpolation. There was no interpolation done to keep the integrity of the data. It was suggested that the sharing of the code will eventually be available on GitHub.

After the presentations discussions followed regarding S-104 resolutions vs S-102 coverage. Additionally discussions on whether there should be meta-data included and whether to tell the user what the S-104 data is based on; this would have to be an S-98 requirement. No conclusion was drawn in this regard.

5.12 Engagement with S-100WG and other relevant subordinate bodies.

The Chair (GBR) had attended the DQWG 19 meeting, via VTC (25-26 March 2024) where he gave feedback and updates on TWCWG activities. He presented a general background on the TWCWG work plan items. The main focus being on S-104 and S-111 Data Quality elements and the 'reduced scope' of S-104; specifically the Uncertainty attributes, Uncertainty Dataset and Definition of surfaceCurrentSpeed modified to distinguish it from speed in general. He also provided feedback on the discussion of DQWG documents we had during TWCWG7.

The USA (Raphael Malyankar) verbally summarized developments at S-100WG 9 of interest to this group. The Chair was not called on to give an unofficial TWCWG report at that meeting. USA and GBR discussed matters of importance taken from this meeting with the focus being on the changes that need to be made to the relevant TWCWG documents as discussed earlier in the meeting. The changes to be made to the maintenance processes on IHO Resolution 2/2007. Although nothing was decided, machine-readable artefacts will need to be looked at. Overall, the S-100 Working Group were content with most of the business. Ed 6.0.0 of S-100 is proposed for 2026 with the final product needing to be completed by 2027, so there is still time to approve any additional changes that may need to be made to S-104 and S-111. S-98 addition 2.0.0 is under active development and was scheduled to be finalized in March 2025. Upon completion of the updating of the catalogue with the relevant approved changes, the new versions of the catalogue will be promulgated.

TWCWG submitted 2 proposed changes that are still pending within S-100 (evident within the minutes of the S-100WG 8 meeting). Possible additional changes were put forward by GBR and discussed. It was decided to include the S-102 PT Chair discussion on Projected vs Unprojected data types in the S-104 and S-111 PT meetings. The next S-100 Working Group meeting will be held in September 2025.

The USA (Lawrence Haselmaier) reported back on the S-102, S-98/S-164 sub-group discussions. The question of how TWCWG was going to allow UTM and UPS data in S-102 and multiple vertical datums in a single cell for S-102 was posed. They plan to allow UTM & UPS data in S-102 both administratively and technically (S-98 Annex C). For allowed projected data, S-100 only allows grid origins/spacing in arc degrees, no guidance exists in S-98 Annex C for projecting back to WGS84. TWCWG was invited to endorse the following proposals and/or provide feedback, where all changes allowed are in S-100 (Ed 5.5.1) Table 10c-12, applicable to subsection **dataCodingFormat = 2 or 9**:

- a. **Longitude of grid origin** proposed changes:
'The longitude or easting of the grid origin. ~~Unit: Arc Degrees~~ The unit must conform to the CRS used for the dataset. I.e., for a geographic data set, the unit must be degrees, and for a projected data set, the unit must be metres.'
- b. **Latitude of grid origin** proposed changes:
'The ~~longitude~~ latitude or northing of the grid origin. ~~Arc Degrees~~ The unit must conform to the CRS used for the data set. I.e., for a geographic data set, the unit must be degrees, and for a projected data set, the unit must be metres.'
- c. **Grid spacing, long** proposed changes:
'Cell size in the X/longitude dimension. This is the X/longitudinal component of the offset vector (S-100 Part 8, clause 8-7.5). ~~Units: Arc Degrees~~ The unit must conform to the CRS used for the data set. I.e., for a geographic data set, the unit must be degrees, and for a projected data set, the unit must be metres.'

To cross the technical hurdle, the formulae from the [IOGP 373-07-02](#) (August 2024) report was used as a starting point. The report shows conversion formulas that have transverse Mercator formulas that are the best to use in the UTM cases. For the UPS, north and south cases were split for simplicity of use.

ACTION ITEM	Action Required	Actions	Deadline
23	Endorse the above proposals and/or provide feedback, where all changes allowed are in S-100 (Ed 5.5.1) Table 10c-12, subsection dataCodingFormat = 2 or 9:	S-104 PT and the S-111 PT	TWCWG10

The S-102 PT began accommodating multiple vertical datums in a single product, Ed 3.0.0 which is out for MS approval. Vertical datum regions will likely be generated as polygons where boundaries will not neatly follow grid cells and overlap is expected at an interface between two datums. The Common Point Rule is intended to resolve this type of overlap (preferring the shoalest answer). Where 2 producer's data overlaps, the mariner must be prompted to select the desired dataset. TWCWG was invited to comment on whether they envision S-104/S-111 will go along the same lines and to otherwise continue the discussion within our PTs.

ACTION ITEM	Action Required	Actions	Deadline
24	Comment on whether TWCWG envisions S-104/S-111 will go along the same lines as S-102 for multiple vertical datums and to otherwise continue the discussion within our PTs.	S-104 PT and the S-111 PT	TWCWG10

It was advised that multiple validation tests and cross-product validation tests will need to be done to compare datums between multiple products. If this is taken up by the implementers and included in Annex C, it is not obligatory. However, if the projected data is going to be used the standards will need to be followed. The level of transformation is in the order of mm, with the grid in meters. It was questioned if the data producers need to do these projections for S-104/S-111 and if so, what validation checks have been missed that need to be added. This is something the PTs will need to discuss and bring to TWCWG10. ECDIS manufacturers are willing to accommodate this requirement if the producers wish to use projected data over areas.

FIN stated what S-102 is proposing is useful for not only HO's but other agencies that may be in the position to produce this type of projected data products. They suggested that the S-104 and S-111 PTs follow what the S-102 PTs are doing.

Section 6 IHO Resolutions and Charting Specifications

6.1 Review of relevant IHO Resolutions.

A question was posed on the time zones to be used, which is on the maritime time zones versus the ISO principles, as a resolution this is a recommendation not an absolute.

6.2 IHO Resolutions - Chart Datum definition in non-tidal areas (and tidal areas).

During TWCWG8, BRA showed a presentation on a survey carried out concerning datums in non-tidal waters. The survey was re-submitted for completion and the results of the survey were further-discussed. The results of this survey suggest MS should think about this topic and possibly discuss it at TWCWG10 if necessary. The results, in a pdf of the presentation, are available if relevant to specific MS. The survey also looked at several questions about the IHO publication M3. BRA also reported back on the results of the survey done on CD. In some cases MSL cannot be used due to wet/dry season.

It was suggested that the definition of '*Seldom...*' included in C-13 or another document be re-defined. The IHO fed back that rather than change the technical resolutions, which is a long process, make a technical note/supplement to them. It was suggested that the *List of Vertical Datums* could be used to describe Chart Datum (agenda item 4.9). USA (Peter Stone) suggested that TWCWG could possibly use these suggestions/comments for the update on the IHO manual of hydrography that needs to be completed in 2026.

ACTION ITEM	Action Required	Actions	Deadline
25	Follow up on the outcomes of IHO CL03/2022 and report back to WG.	IHO Chair (GBR)	TWCWG10

6.3 Review of relevant IHO Charting Specifications.

The IHO reported that part of TWCWG's mandate is to review relevant sections of IHO publications. At the time of TWCWG9, nothing specific regarding any of the publications had been received. This is highly recommended by the IHO to carry out these reviews so MS can make adjustments. Within these publications, there are concessions for MS to use National requirements. When suggestions are made from MS, individuals or working groups there are processes to be followed. Anybody can make suggestions on changes however these must be brought to the Working Group for discussion, especially if the suggested recommendations need to be addressed by another working group or their actions. Once the suggested change/changes are approved by the consensus of TWCWG it is then submitted as a recommendation by TWCWG versus an

individual request.

CHL commented that B-406.1 mentions positions to the *nearest minute*, however, this does not conform to B-130 and B-131 which indicates that locations must be to the *decimal minute or second*; creating discontinuity. It was agreed by MS that this should be changed to the *nearest minute as a minimum*. In the Spanish version, B-496.4 does not occur in the English version and should thus be removed from the Spanish version. **This is an outstanding action from TWCWG7**

A discussion was held regarding changes to S-44. BRA (Felipe Santana) brought forward several changes. The working group decided that a paper should be formulated on the possible required changes for S44 to be circulated to TWCWG members before TWCWG10 for comment and approval before being submitted as a formal recommendation.

ACTION ITEM	Action Required	Actions	Deadline
26	1. Report discrepancies between B-406.1, B-130 and B-131. 2. Suggest amending all 3 to read ' <i>...nearest minute as a minimum...</i> '	IHO Chair (GBR)	TWCWG10
27	1. In the Spanish version remove para B-196.4	IHO Chair (GBR)	TWCWG10
28	Formulate the paper on the possible required changes for S44 to be circulated to TWCWG for comment and approval before being submitted as a formal recommendation	BRA (Felipe Santana) ALL	TWCWG10

Section 7 **IOC Programmes**

7.1 Update on IOC Global Sea Level Observing System (GLOSS) Programme items and events.

Garry Mitchum, as outgoing Chair of GLOSS, reported back on GLOSS activities. The new Chair of GLOSS will be elected at the next meeting in Panama, Feb 2025.

A problem that has been identified is that a single TG can have multiple organisational numbers attached to it. Thus if two TG's are in the same place, do they have a single number or multiple numbers? GLOSS is discussing this issue and once recommendations on this issue have been decided on they will provide feedback on this at TWCWG10.

Garry Mitchum explained what the criteria was for a TG to be considered as a GLOSS station. In the 1980's, the GLOSS network was just under 300 stations and now has 1000's of stations, many of them having multiple 'numbers'. The amount of data being received from TG's around the world has increased exponentially over time. If a station enters its data stream it does not automatically make that station a GLOSS station, but the core network will be a special sub-set of GLOSS as this often helps with obtaining funding for some countries. GLOSS is now in the process of re-evaluating this and it will be discussed at the next meeting. SWE asked if it would not be simpler to have a joint system as the same data contributions are going to separate sectors, thus not only a unified numbered naming system but a unified data portal. GLOSS indicated that this is something they have considered and it is in process/under development. CHL wanted to know when a MS contributes data to a database and the data is downloaded and how the contributing organisation gets credit for the data. GLOSS responded that it is something they need to consider. The IHO Sec Gen asked about the involvement of GLOSS in forecasting and future climate change studies. GLOSS responded that this is looking at regionally, to local levels; GLOSS measures sea level rise and projections thereof. GLOSS gauges are used for high tide

flooding for inundation studies and low-intensity, frequent flooding events (street-level flooding, affecting traffic/ business etc.). Also, they use the information for normal seasonal cycle understanding.

BRA mentioned that they had sent around an email to MS to compile a list of publications on analysis, predictions etc. GLOSS stated that they are doing something similar and suggested that GLOSS and TWCWG work together from a national and international level.

The World Meteorological Organisation (WMO) has an interest in the GOOS group and has expressed an interest in being involved, but this may be a misconception that Met Agencies are running tide gauges. GOOS is under the impression that Meteorological Offices are the only ones running TG networks, however, GLOSS is trying to get them conscious of the fact that it is HOs/Navy/geodetic agencies etc. that need to be included as National Agencies responsible for the TG networks, which varies from country to country. GLOSS suggested that there be a dedicated IHO representative on the GLOSS Steering Committee versus only the MS who attend the experts meeting.

ACTION ITEM	Action Required	Actions	Deadline
29	1. MS to Supply BRA with a list of analysis, predictions and any other relevant publications. 2. TWCWG and GLOSS to collaborate on this project	ALL BRA (Felipe Santana) GLOSS	TWCWG10
30	Appoint a TWCWG MS to represent TWCWG at the GLOSS Steering Committee (Volunteers to submit names to TWCWG Chair/Vice-Chair and IHO)	ALL IHO Chair (GBR) Vice-Chair (ZAF)	TWCWG10

7.2 Update on IOC Tsunamis & Other Hazards Related to Sea-Level Warning & Mitigation Systems (TOWS) Programme items and events.

CHL (Julio Castro) gave feedback from the TOWS WG XVII meeting held in Feb 2024, where task teams on Tsunami Watch Operations (TT TOWS) reported back on their progress throughout the previous cycle. The following recommendations and actions from the TT TOWS to TWCWG are:

- The dependency of Tsunami Service Providers (TSP) and National Tsunami Warning Centres (NTWC) on seismic and sea level information,
- The new requirements to monitor sea level at enhanced resolution to be able to detect and warn for tsunamis generated by non-seismic sources,
- Review the previously recommended data format for sea level data and update as required to ensure facilitates exchange of data at required resolutions and sampling rates, and to ensure data format contains meta-data to enable TSPs and NTWCs to determine the level of individual station suitability for tsunami detection and warnings,
- TPSs routinely monitor (at least every 6 months) the status of sea level observing networks and the quality of the data to meet existing and enhanced tsunami warning requirements in their Area of Services, including the provision of status summaries for the Secretariat to follow-up with relevant MS to correct data issues (coverage gaps and data quality),
- The routine monitoring of national sea level and seismic observing networks. Sample sea level data at one-second intervals and transmit this in real-time in order to share information and procedures on deployments of new technologies to monitor sea level variations, and

- f. Increase the tabled sea level data at one-second intervals (where available) and display sea level time series as a continuous line.

Section 8 Capacity Building

8.1 Tides and Water Levels Workshop training material.

ZAF introduced the topic of discussion and called for any comments or revisions that needed to be made to the existing work already completed. No comments, corrections or inclusions were received.

The USA (Peter Stone) gave an update on courses the USA have been running in Costa Rica. NOAA has also done a similar tide training course in the western hemisphere which they are working on upon a request from IOC. There is a possibility of having a course in Puerto Rico and the IOC is providing coordination and funds for this course in conjunction with the IHO Capacity Building Sub Committee (CBSC). Peter Stone relayed a request from GLOSS, there is a real lack of supporting documents/manuals in Spanish. If anybody knows of or has any manuals/documents in Spanish to please let Peter know as it would be extremely beneficial to have these copies to assist with the training.

As a result of the discussions regarding S-104 and S-111, multiple MSs indicated that they had inadequate understanding of these products. A requirement for S-104 training for these smaller HOs has been identified. This mini-training course/workshop will need to identify exactly what type of training is required and should include a general introduction to S-100, what it is and how it will work. Additionally, what is S-104 and its purpose, with a possible introduction on how these products will be created, the terminology used in discussions should also be covered. A training course/workshop will need to be requested via CBSC.

ZAF introduced the work that the South African Navy Hydrographic Office (SANHO) and the Institute for Maritime Technology (IMT) are doing on a digital platform for blended learning. This platform was created using the information and outcomes for the Cat B Hydrographic Survey Officers curriculum on tides, water levels, vertical datums and oceanography (including currents). The intention of this platform is not to replace a facilitator/trainer but to enhance training in an interactive way with content, graphics and video clips. ZAF stated that they are aware of some technical issues but are awaiting assistance from IMT on this. ZAF very briefly went through how the platform worked and showed several of the various ways in which the platform would enhance training. The integration of 'progress tests' are still in development. The SANHO requested volunteers to go through the content of the modules and identify any wording/content changes that may be beneficial and to supply ZAF with any suggestions on additional content.

BRA queries if the content would only be available in English or if translations would be done. ZAF responded that for now, it would only be in English. DNK gave positive feedback on the design of the site with the USA stating that the 3D diagrams and animations are helpful. AUS has provided similar content for their S5A and S5B courses, suggesting that it would be useful to check the consistency of the 2 platforms' content. FIN volunteered to check the tides modules and USA volunteered to check the currents section.

ACTION ITEM	Action Required	Actions	Deadline
31	USA requires Spanish manuals/ documents or training material for Capacity Building. If MS have such material to please inform Peter Stone.	ALL USA (Peter Stone) GLOSS	TWCWG10
32	1. A training course/workshop on S-104 to be requested via CBSC for TWCWG MS 2. Need to identify exactly what type of training is required. Should include a general introduction on S-100, what it is and how it will work. 3. What is S-104 and its purpose with an introduction on how these products will be created, the terminology used in discussions should also be covered	Chair (GBR) IHO USA (Greg Seroka)	TWCWG10
33	1. MS still wishing to volunteer to request access via email from ZAF (ruthfarre241@hotmail.com) 2. Submit feedback and comments for content improvement to ZAF. 3. AUS to compare contents for consistency before TWCWG10	ZAF AUS USA (Carl Kammerer) Fin (Anni Jokiniemi) ALL	30 June 2025

Section 9 Any Other Business

9.1 Offer by the Hydrographic Surveys WG (HSWG) for TWCWG collaboration to improve tidal observation uncertainty standards within the relevant sections of S-44 (Standards for Hydrographic Surveys).

BRA, as Lead of the PT tasked with looking at this topic, explained the context of the work being done indicating that S-44 holds limited information on tidal observation uncertainties. In Ed 6.1.0, the only tidal observation/measurement uncertainties mentioned are those for *Water Flow Direction* and *Water Flow Speed*. S-44 is intended for a global audience and techniques could range from very simple to extremely complex (best practice); subsequently the uncertainties should be equipment agnostic related. Although S-44 is for hydrographic surveys, it is not exclusively for the safety of Navigation. It is important to distinguish the difference between uncertainties and specifications. A country may define national specifications on uncertainty standards that are not included in the S-44. Within the relevant S-44 table, the minimum standard for safety of navigation is included however there are uncertainties S-44 does not include such as time, height and flow. David Parker and Carlos Marques from HSWG reported back that they have begun working on updating the relevant sections of S-44 and subsequently created a small Project Team (PT) to work on this. A relevant documentation for the update of S-44 is the list of publications being compiled by BRA (item 7.1), which is available at the following link:

(<https://onedrive.live.com/?authkey=%21AGc8FXv5CL4ZR9A&id=001545084C3C137C%21739523&cid=001545084C3C137C>)

During the last PT meeting the following issue was identified: Are *Water Flow Direction* and *Water Flow Speed* the correct/relevant terms and does the term current mean or cover all water flow? The terminology should be consistent with S-111 standards. It may be necessary to explain the terminology in the 'Glossary' section. The PT decided that as long as it is correctly defined in the Glossary this is the best course of action. PT to define the wording for the glossary.

Another point of interest identified by the PT was whether *time* should be included. The PT decided that it is

not necessary as S-44 is intended for bathymetric surveys and water flow already accounts for the uncertainty of the speed and direction. The HSWG Chair recommended that the aforementioned be included in S-44, however, the general consensus from this group was that the current time uncertainty is already 'baked into' the uncertainty. If it was to be included the difficulty would come in in how to define the term and that it is difficult to quantify. The PT proposed tabling this until a concrete definition can be agreed upon.

At present there is no mention of water level height. The HSWG clarified that, with respect to water levels, only the uncertainty of height measurements concerning the specified vertical datum is being considered. The uncertainty of predictions is not being taken into account. Additionally, the uncertainty of water levels is not intended to be considered solely as a component of sounding reduction, although understanding the measurement uncertainty of water level observations will be beneficial for computing the overall vertical uncertainty of soundings when tides are used. It was suggested to avoid addressing the uncertainty of the vertical datum itself, assuming that the datum and its relationship to other datums have zero uncertainty. Regarding sounding reduction, datum uncertainty is considered elsewhere. . The PT believes that including these criteria will create complications for the surveyor specifically to achieve the required survey order.

TVU criteria often doesn't include water height, as this is not defined within S-44, it is considered that this might be relevant for other applications and possibly should be defined. AUS asked what would be the intent for this water level uncertainty, and it would not need to be available to countries still doing more traditional sounding reductions. The definition of water height is already in other standards and thus re-defining it is creating a duplication of work. It was suggested that S-44 could reference the other standards vs duplicating it in S-44. BRA mentioned that when taking into account GNSS tides various uncertainties exist, therefore perhaps this should be included. The ensuing discussion on this topic resulted in the decision that the PT look into the relevant standards that already exist, create a list of these documents, create maximum and minimum values range and supply this list to HSWG.

BRA believes that a note could be included in S-44 or C-13 stating that these values are recommended for meeting the Survey Orders but are not mandatory requirements. They serve as indicative guidelines, meaning that if they are met, there is a higher likelihood of achieving the TVU. Additionally, other combinations can be tailored for different applications using the tables in item 7.6.

NOR, ZAF and FIN suggested that perhaps S-44 is not the correct place to include this information, there are many other platforms or documents that have this information already. IHO suggested that it may be better placed in C-13. The IHO emphasised that it is valuable information, agreeing that S-44 might not be the right place for it. The USA stated that instead of saying 'this is the uncertainty' make it imperative that if the uncertainty is known it should be supplied and linked to the standards. BRA felt this should be re-discussed within the sub-group before it is brought back to TWCWG. The IHO brought up another perspective being that the S-44 is being used as a way of seeing if the data has value for crowd-sourced bathymetry. In this instance the biggest error is 'tide', so understanding the uncertainty of these values is important. It could be used for satellite-derived bathymetry where it is either too dangerous or not economically viable to survey, but if there is a control point the data can be made more accurate. The Chair re-iterated how valuable it is to have this information, so yes, Water Height needs to be added. The PT is to advise on this per ACTION 35 above for discussion at TWCWG10.

BRA read the introduction and the definition of the matrix from S-44 to give a better understanding of what is required from TWCWG about the necessity of adding the definition of Water height. Water height is mentioned multiple times within S-44 and it is now evident that this definition needs to be updated within S-44. BRA proposed that water height could be included in the matrix (Table 7.2 Table 2), rather than the table of uncertainty. The values in the matrix are focused on the value of the data only, not on the equipment. The highest possible accuracy of height that can be achieved should be included in the matrix.

A discussion was held about where and how to put the inputs from TWCWG into the S-44 document. The Chair is to submit a statement of intent to HSWG by Feb 2025. The PT is to propose changes to S-44 and put those proposed changes to TWCWG for approval, before submitting to HSWG, with the final inputs from TWCWG in September 2025.

On the premises of what was previously discussed, Water Level Time is not necessary to be included.

Across the Survey Orders, do we need separate uncertainty measurements of the agreed criteria for each Survey Order? In regard to Water Level Height, it should refer to a single point, so the uncertainty is a threshold to Chart Datum and not a water level height surface. It is a single station measurement point.

To the question do we need separate uncertainty measurements of the agreed criteria for each Survey Order? *Water Flow Direction* and *Water Flow Speed* should be maintained for measurements. It is inaccurate to use the same criteria for each survey order as in narrow fairways, sound flow speed and direction should be provided for far more accurately than open waters. Water flow direction and speed varies according to the real-time depth and space making it impossible to evaluate the uncertainty. It needs to be noted that the uncertainty of the instrument is for a specific location.

It was proposed that a method or methods on the standard for calculations of the uncertainties for S-104 and S-111 be included. The USA (Greg Seroka) stated that they have a document that can be used as a starting point. The USA (Peter Stone) will supply the document, once it is completed, to aid in this Action.

ACTION ITEM	Action Required	Actions	Deadline
34	Define <i>Water Flow Direction</i> and <i>Water Flow Speed</i> in line with S-111 in the Glossary of S-44.	S-44 PT	TWCWG10
35	A statement of intent to be submitted to HSWG about where and how to put the inputs from TWCWG into the S-44 document	Chair (GBR)	28 Feb 2025
36	1. Propose changes to S-44 and put those proposed changes to TWCWG for approval 2. Present to TWCWG10 for approval. 3. Submit to HSWG	S-44 PT	30 Sep 2025
37	Propose a method or methods on the standard for calculations of the uncertainties for S-104 and S-111.	USA S-44 PT	30 Sep 2025

9.2. Minimum metadata requirements for tide & water level gauges

Liz Bradshaw from NOC introduced the topic with a brief explanation of intent. She explained that they had previously been working with delayed mode data and are now getting hourly delayed mode data. NOC displayed an example of the metadata scheme they have developed where Copernicus metadata fields were used as the basis. Thus, wherever the data was collected from now has a minimum metadata requirement and the metadata fields have been created for this. Wherever possible, the metadata is pulled out through API's. Presently this list is in the form of a free-flow text list. GBR confirmed this is a good list and the vertical datum is of most importance to TWCWG. Peter Stone enquired if there was associated documentation on this i.e. SOP. NOC stated that there is and it describes the format of the data. NOC will supply the relevant documents to the Chair. CHL (Julio Castro) stated that the VLIZ website has this data already.

SWE stated that in Copernicus the ability to download these metadata files is available. SWE suggested that the potential to use this metadata list is multi-functional. It was queried whether the HDF5 files also have these metadata fields. If they did, this would standardise the metadata into the global attributes.

ARG enquired as to how datum shifts were handled in the datasets and metadata. NOC (Andy Matthews) stated that the database has no info on things like GNSS, co-location, datums and benchmark information. ZAF stated that they have 2 historical datasets, one that has the data as recorded to its original datum and the second has all historical data that has been 'amended/re-adjusted' to the current CD.

What is the minimum requirement to make a TG a GLOSS Station? BRA asked if it was about the quality of the data as opposed to the minimum metadata. NOC fed back that this will be discussed further at the steering group in so far as what constitutes a GLOSS gauge (see also Agenda item 7.1) , however, the data centre will decide as to whether the data quality is appropriate for GLOSS purposes. TWCWG MS were asked to look at the metadata list and to please forward any feedback directly to Andrew Matthews and Liz Bradshaw

9.3. Survey on Tides, Water Levels and Currents.

At TWCWG8. 'KHOA (Republic South Korea) showed the results of their survey on Tides, Water Levels and Currents. This survey identified the status of S-104 and S-111 in each country, however, only 9 countries responded. Canada and RSA stated that they had completed the survey, but it appears it was not received by KHOA. The results of the survey were gone through. The survey is to be repeated and results are to be presented at TWCWG9'. The excellent work carried out by KHOA on the initial survey was recognised by the Chair and the TWCWG, with KHOA being requested, by the Chair, to repeat the Survey on tides, water level and currents; data production method and data format (S-104 & S-111 products) with the results presented at TWCWG10.

ACTION ITEM	Action Required	Actions	Deadline
38	NOC to supply the metadata list and any other relevant documents to the Chair for distribution to TWCWG	NOC Chair (GBR)	TWCWG10
39	Supply any feedback on the metadata list directly to Liz Bradshaw (elizb@noc.ac.uk) and Andy Matthews(antt@noc.ac.uk)	ALL NOC	31 Jan 2025
40	1. Survey on tides, water level and currents; data production method and data format (S-104 & S-111 products) to be carried out 2. Results to be presented at TWCWG10	KHOA All	TWCWG10

Section 10 Work Plan and ToRs

10.1 TWCWG Work Plan 2025-2026 updates

The work plan for 2025-2026 was amended and will be submitted to HSSC17.

10.2 Review TWCWG ToRs and RoPs.

Nothing to report.

Section 11 Venue and dates of the 10th TWCWG Meeting (TWCWG10)

TWCWG10 is to take place 4-7 November 2025 with a location to be decided.

Section 12 Review of Action Items from TWCWG9

The Action Items were gone through and all members present endorsed these. Finland is to be added to the MS list.

Section 13. Development of TWCWG9 report to HSSC17

The Chair stated that this was in hand, He and the Vice-Chair would have this ready for HSSC17.

Section 14. Draft Agenda for TWCWG10

The Chair stated that this was in hand.

Section 15. Closing

The Chair expressed his appreciation to all for making the meeting possible with the various time zones and their commitment to TWCWG. The Chair, Vice-Chair and IHO thanked all the staff at the IHO for the preparations and their hard work during the meeting. All those in attendance, specifically those attending online from various time zones, were thanked for their participation in what was yet another very productive meeting. The Chair, Vice-Chair and IHO each stated they were looking forward to seeing as many people as possible at the in-person meeting in November 2025.